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the coral reefs and rock pools, localities in which the greater number of the yet unknown fishes of the tropics are likely to be found.

Evermann and Marsh are to be congratulated on the use of the correct name of the island of Puerto Rico, instead of the lazy corruption of Porto Rico. This is, we believe, the first government document of the United States in which the name is correctly spelled. The spelling Puerto Rico is, however, now officially adopted by the Government Board of Geographical Names.

D. S. J.

Tunicates of Pribilof Islands. — Part III of "The Fur Seals and Fur-Seal Islands of the North Pacific Ocean," published by the Government, contains an account by W. E. Ritter of the Tunicates of Pribilof. Eleven species are reported upon, ten of which are new to science.

Physiology of the Cephalopods. — An excellent résumé of our knowledge of the physiology of the cephalopods has been given by Victor Willem in the *Bulletin Scientifique de la France et de la Belgique*, Tome xxxi, pp. 31-54. The article is accompanied by an extensive bibliography.

Excretion in Mollusca. — Cuénot¹ has studied the function of excretion in mollusks by means of physiological injections, and attains results which modify some generally accepted views derived from anatomical and histological data. From the review of the literature on Mollusca one sees that the excretory function has been ascribed primarily to the nephridia (organs of Bojanus), then also to the pericardial glands of lamellibranchs, and finally without sufficient proof to the modified pericardial epithelium and to certain scattered liver cells.

The interior of any animal maintains a relatively constant composition, due to the presence of excretory cells which remove any excess of normal material or any abnormal, *i.e.*, excretory, substance which would poison the organism. The cell exercises, however, the choice among such substances, thus demonstrating the varied nature of the excretory cells. Introduced substances may (1) enter into the cycle of metabolic changes; (2) be attracted and precipitated in skeletal or yolk material; (3) undecomposed and unfixed, be collected by excretory cells, and thus impart color to the excretory organs. Certain

¹ Cuénot, L. L'excrétion chez les Mollusques, *Arch. de Biol.*, vol. xvi (1899), pp. 49-96, Pls. V, VI.

cells absorb some substances with avidity, but are totally indifferent to others.

Among the variable types of excretory cells two appear to be constant; the first absorbs indigo-carmin and refuses ammonium-carminate, while the second precisely reverses this action. Rarely excretory cells do both, but even then the one more freely than the other. These two types are associated with voluminous organs. The indigo kidneys produce urea, uric acid, and urates, while in carminate kidneys, thus far known, none of these substances are formed, though some non-indigo excretory cells contain urates. A tabular view of such organs for various groups of animals is reproduced on the opposite page, together with the products of each organ so far as known.

After discussion of the special technique employed, the author lists the various names by which the connective-tissue cells of mollusks are designated by different investigators, and distinguishes at least two types of such cells: (*a*) Reserve cells enclosing glycogen, and (*b*) excretory cells. In the terrestrial pulmonate gastropods the two functions are associated in a single cell, as in the liver cells of vertebrates.

In two groups of mollusks the nephridia, instead of being lined throughout their entire extent by a single type of excretory cell, present noteworthy differences: in Amphineura the reno-pericardial ducts of acid reaction eliminate actively carminate and litmus, while the rest of the nephridium, formed of different cells, and with alkaline reaction, eliminates indigo. In prosobranch gastropods the nephridia present a series of anatomical and physiological differentiations: Patella has two nephridia, very different in size but both eliminating equally indigo; in Trochus and Haliotis the larger right nephridium absorbs indigo alone; the left nephridium, very different in structure from the other, becomes faintly colored by carminate; finally, in monotocardic prosobranchs the single nephridium possesses two sorts of cells. The most numerous, non-ciliate, eliminate indigo; the others, ciliated, eliminate only carminate—the single nephridium being thus a physiological equivalent of the two nephridia in the Diotocardia (Trochus, etc.).

In the Amphineura, Solenoconcha, and Gastropoda there are, in the connective tissue, numbers of cells acid in reaction, of which the vacuoles actively absorb carminate and litmus. These scattered cells correspond physiologically to the pericardial glands of lamellibranchs and to the branchial heart of cephalopods which have the same power.

MIXED KIDNEY (INDIGO AND CARMINATE).

Vertebrates (Mammals, Bufo, etc.)	Convolute tubules of kidney (alkaline)	Urea, uric acid, hippuric acid, etc.
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INDIGO KIDNEYS.

Tunicata (Phallusia, Molgula)	Closed kidney or blind vesicles	Uric acid
Sipunculida (<i>Phascolion strombi</i>)	Nephridium (acid)	Urate
Pulmonate gastropods (Oscanius)	Nephridium (acid)	Uric acid
Lamellibranchs	Nephridia (acid)	Urea, etc. Uric acid in Lutraria
Cephalopods	Nephridia	Uric acid in Sepia and <i>Octopus macropus</i> , Guanine or Xanthine in <i>O. vulgaris</i>
Crustacea decapoda	Labyrinth of antennal kidney and often vesicle (alkaline)	Leucomaine?
Chilopoda (Lithobius, Scolopendra, Geophilus)	Malpighian tubes	Urates and uric acid
Diplopoda (Iulus)	Malpighian tubes	Sodic urate and calcic oxalate
Insecta	Malpighian tubes (alkaline)	Very often urates and uric acid

CARMINATE KIDNEYS.

Lamellibranchs (Pecten, Cardium)	Pericardial gland (acid)	Hippuric acid and sodic hippurate
Hirudinea	Convolute portion of nephridia	Leucomaine?
Crustacea decapoda	Vesicle of antennal kidney and branchial kidneys (acid)	Carcinuric acid
Scorpions	Liver	Guanin

The pericardial glands of lamellibranchs manifest three different types: intra-auricular masses in *Pecten* and *Ostrea*, external epithelium of the auricles (*Mytilus*), tubular glands opening virtually into the pericardium (*Naiades*). *Pecten maximus* affords a clear transition from the type of the lamellibranchs to that of the gastropods in that the connective tissue encloses, as in the latter, many isolated cells, which are massed in the wall of the auricles. The products in the cells of the pericardial glands of either type are engulfed by phagocytes, which transport them into lacunæ of the circulatory system. Some of these phagocytes reach the exterior through the branchial membrane; the others become fixed for life in the connective tissue.

In the cephalopods the excretory connective-tissue cells are accumulated exclusively in the wall of the branchial heart and of the appendix to that organ. In both organs, however, cells of a different character are present. In various gastropods (*Pulmonata*, *Opisthobranchiata*, and some *Prosobranchiata*, as *Cyclostoma*) the liver contains numbers of excretory cells which discharge their products into the intestine.

The collaboration of closed excretory cells and phagocytes to eliminate waste products, or at least to localize them in indifferent regions, is found in many groups: *Oligochæta*, *Polychæta*, *Hirudinea*, *Sipunculida*, *Echinoderma*. This method of excretion, which encumbers the tissue with masses of solid granules increasing with age, is evidently an imperfect function, and not improbably contributes to determine the death of the individual.

HENRY B. WARD.

The Heart of Anodonta.—The action of the heart of *Anodonta* has been fully studied by V. Willem.¹ Under ordinary circumstances the heart beats four to six times per minute. Contraction can be induced in an empty, quiet heart by injecting fluid into it, but an overfilling of the heart will retard the rate of contraction. The contraction of the ventricle drives the blood out under a pressure of one to three and a half centimeters of water. When the ventricle contracts, the auricles expand, and together these organs always fill the whole pericardial space. The contraction of the ventricle acts as a suction pump on the blood in the gills, drawing it into the auricles, and as a force pump on the blood in the arteries.

G. H. P.

¹ Willem, V. Recherches expérimentales sur la circulation sanguine chez l'*Anodonte*, *Mem. couron. Acad. Roy. des Sciences, des Lettres, et des Beaux-Arts de Belgique*, tome lvii, 28 pp., 2 pls., 1899.